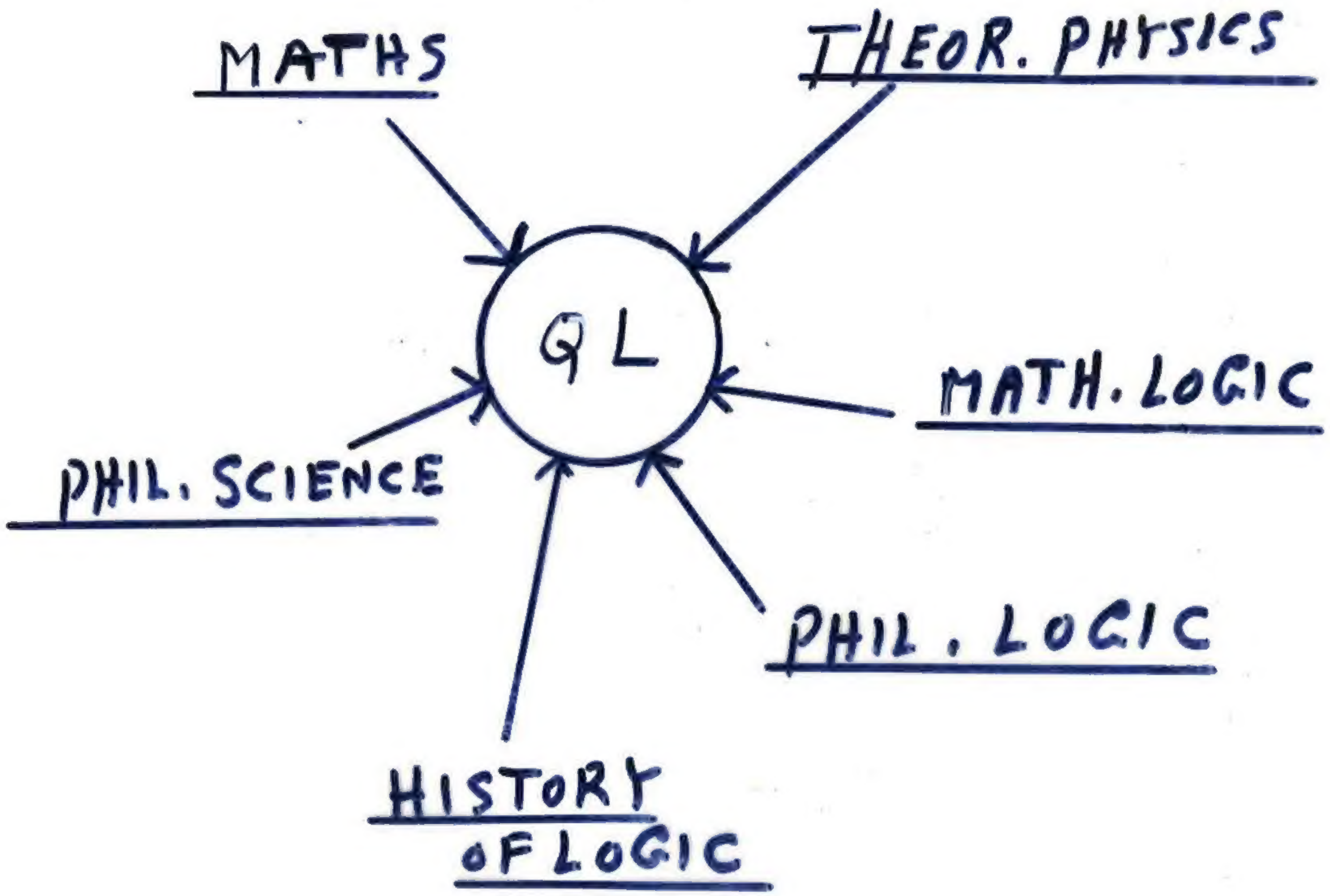
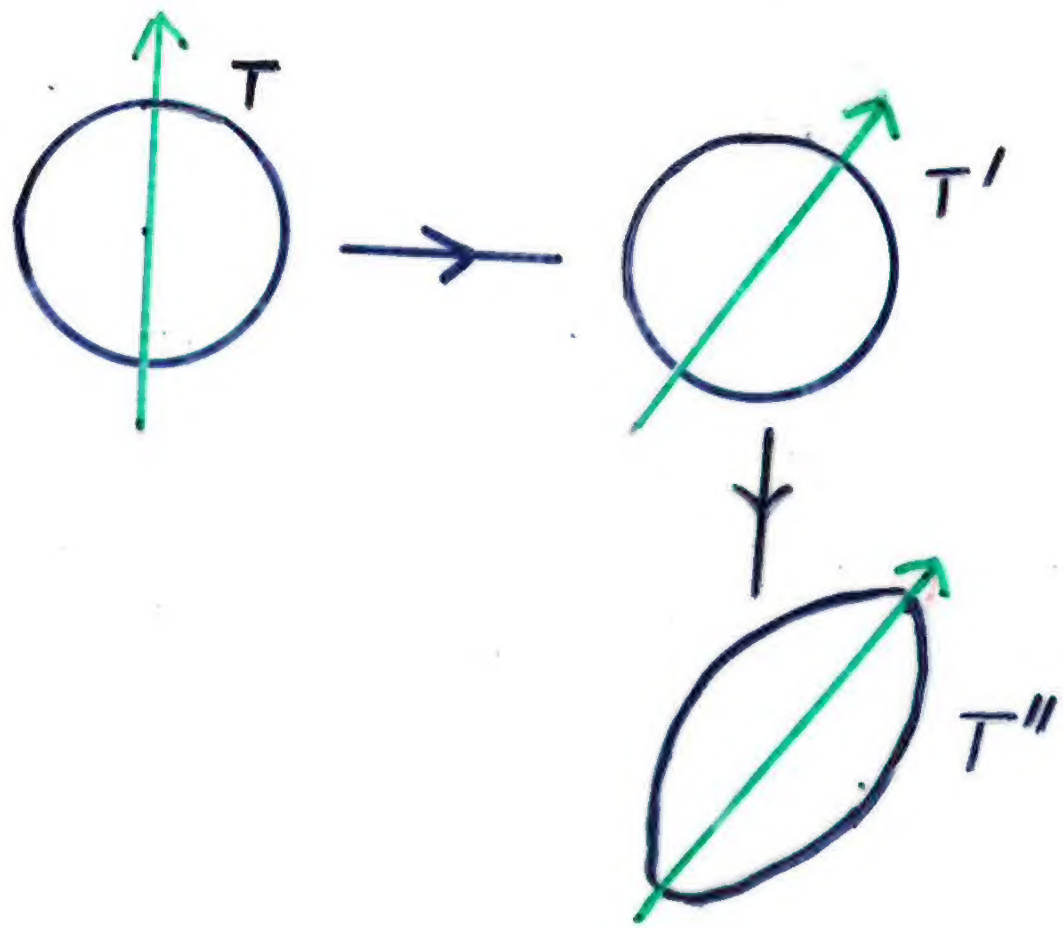
INPUTS TO QL.


MATHS
THEOR. PHYSICS
QL
MATH. LOGIC
PHIL. SCIENCE
PHIL. LOGIC
HISTORY OF LOGIC

REFORMULATION AND 'STRETCHING'



HISTORICAL DEVELOPMENT of QL.

French Empiricist School of Logic : Gonseth, Bachelard etc

Many-Valued Logics

Technical development by Lukasiewicz (1920) and Post (1921)

→ Application to QM suggested by Zawirski (1931)

3-Valued QL.
↓ Destouches-Février (1937)
Reichenbach (1944)

↓

Supported by Putnam (1957)

- **Non-Distributive QL**

Birkhoff and von Neumann (1936)

Gleason's Theorem (1957) ←

→ Mackey axiomatization of QM (1963)

↓

Geneva School : Jauch, Piron, Misra, Guerin, Emch, etc

+ Varadarajan (1968)

↓

Philosophical Interest

Specker (1960) — Q-validity
Finkelstein (1962) – operational QL.
Putnam (1968) – Resolution of paradoxes.

PUTNAM AND QUANTUM LOGIC

$$\frac{\text{Geometry}}{\text{GR}} = \frac{\text{Logic}}{\text{QM}}$$

$$L + P' = L' + P$$

old Logic

new physics (paradoxes)

New Logic

old Physics (classical realism – no paradoxes)

LOGIC IN CLASSICAL PHYSICS

Phase space of Universe is

$$\tilde{\Omega} = \underset{r \in I}{P} \Omega_r$$

I is set of all particles and fields

Elementary proposition q associates representative point of the Universe with subset Q of $\tilde{\Omega}$.

Compound propositions:

p or q associated with $P \cup Q$

p & q . . . . . $P \cap Q$

$\sim p$ . . . . . $\complement P$

Thus $\mathcal{P}(\tilde{\Omega})$ serves as characteristic algebra for CPC.

LOGIC AND SET THEORY

Set Theory based on Logic:

$$\tilde{A} = \{ y : A(y) \}, \text{ etc.}$$

$$\tilde{A} \cup \tilde{B} =_{Df.} \{ x : x \varepsilon \tilde{A} \vee x \varepsilon \tilde{B} \}$$

$$\tilde{A} \cap \tilde{B} =_{Df} \{ x : x \varepsilon \tilde{A} \wedge x \varepsilon \tilde{B} \}$$

$$C \tilde{A} =_{Df} \{ x : x \not\varepsilon \tilde{A} \}$$

Logic based on Set Theory:

$$A(x) \vee B(x) =_{Df} x \varepsilon [\tilde{A} \cup \tilde{B}]$$

$$A(x) \wedge B(x) =_{Df} x \varepsilon [\tilde{A} \cap \tilde{B}]$$

$$\sim A(x) =_{Df} x \varepsilon [C \tilde{A}]$$

PUTNAM AND THE PARADOXES

ψ_n : Oscar has position n

ϕ_s : Oscar has momentum s

S1 : $(\psi_1 \vee \psi_2 \cdots \vee \psi_n) \wedge (\phi_1 \vee \phi_2 \cdots \vee \phi_n)$

S2 : $(\psi_1 \wedge \phi_1) \vee (\psi_1 \wedge \phi_2) \cdots \vee (\psi_1 \wedge \phi_n)$

$\vdots$

$(\psi_n \wedge \phi_1) \vee \cdots \cdots \vee (\psi_n \wedge \phi_n)$

In C.L. $S_1 \equiv S_2$,

In Q.L. $S_1 \equiv I \wedge I = I$

$S_2 \equiv 0 \vee 0 \vee \cdots = 0$

According to Putnam

S1 says $(\exists x) q(x) \wedge (\exists y) p(y)$

S2 says $(\exists x)(\exists y)[q(x) \wedge p(y)]$

QUANTUM STATES AND PUTNAM STATES